FINAL REPORT

ENERGY SAVINGS OPPORTUNITY SURVEY
ENERGY ENGINEERING ANALYSIS PROGRAM

FORT GORDON, GEORGIA

EXECUTIVE SUMMARY

Administered by
Savannah District, Corps of Engineers
Contract No. DACA21-85-C-0614

HEERY
Heery Energy Consultants, Inc.
Atlanta, Georgia

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F O R T G O R D O N

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EXECUTIVE SUMMARY

I. INTRODUCTION

This is the pre-final submittal of an Energy Savings Opportunity Survey (ESOS) performed at Fort Gordon, GA. This report presents potential energy conservation projects for this Installation. These projects, consisting of Energy Conservation Opportunities (ECOs), are summarized in Tables 1 and 2. The projects were developed based on project packaging instructions from the Installation and on follow-up phone calls with The Directorate of Installation Support (DIS). The ECOs have been extended to include buildings similar to those surveyed by the architect/engineer. Similarity was based on instructions from the Installation and on follow-up phone calls with DIS.

Table 3 lists the buildings surveyed. 39 buildings were surveyed totaling approximately 800,000 square feet. Of these, one was an example of Family Housing and 38 were examples of non-housing buildings. Over one hundred ECOs were considered at Fort Gordon. Of these 39 were applicable in non-housing and 5 in Family Housing.

ECOs were selected for consideration from a number of sources: Annexes A and B of the Scope of Work (SOW), the Army Facility Energy Plan appendix, and Heery's own resources, including the ECOs studied at other Installations. All applicable ECOs were evaluated and found either feasible (savings to investment ratio greater than or equal to one) or infeasible. Tables 4 and 5 list the applicable ECOs along with savings to investment ratio (SIR), project packaging information, and other pertinent data.

A steam trap survey was conducted for Heery and included all areas of the Installation except the Hospital. It found that 12% of the traps had failed, wasting $41,000 per year. ECO No. 14 was developed to meet this problem.

The method of analysis employed for heating and cooling ECOs is a multiple measure approach using a modified bin method as outlined in the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Fundamentals. ECO savings not based upon heating or cooling loads use standard ASHRAE or Institute of Electrical and Electronic Engineers (IEEE) formulas. Electronic spreadsheets employing the aforementioned energy analysis methodologies were used by Heery to perform the energy calculations, and produce the Life Cycle Cost Analysis (LCCA) sheets.

All energy savings are first calculated at the building boundary. For those buildings receiving chilled water or high temperature hot water or other energy from a central energy plant, the computed energy savings are then converted to plant energy savings by the use of conversion factors that reflect distribution losses and energy conversion inefficiencies.

TABLE 1

SUMMARY OF ENERGY CONSERVATION PROJECTS (Non-Housing)
FORT GORDON, GEORGIA

Proj No.	Funding Program	Project Title	ECO No(s).	Energy Savings MBTU/Yr	First Yr. Dollar Savings $/Yr.	Total Investment Cost $	Simple Payback Period Yrs.	SIR
1	QRIP	OA On/Off Control of HW Pump	16	69,456	$337,539	$39,987	0.12	117.69
2	QRIP	Time Control of HVAC	15	206	$2,675	$397	0.15	65.80
3	QRIP	FM Controls for HVAC	35	487	$2,595	$626	0.24	54.35
4	QRIP	Night Setback Thermostat	17	3,170	$15,342	$4,636	0.30	46.26
5	QRIP	Hot Water Reset	11	139	$673	$455	0.68	20.68
6	PECIP	Fixture Retrofit - Incandescent to Fluorescent	29	6,171	$151,693	$109,492	0.72	16.97
7	QRIP	Dual Temperature Thermostats	19	1,724	$12,315	$9,493	0.77	15.33
8	QRIP	Steam Trap Replacement	14	8,379	$40,556	$13,246	0.33	14.67
9	QRIP	Replace Freezer Door Seals	5	119	$1,546	$984	0.64	11.62
10	PECIP	More Efficient Boiler	23	5,486	$26,552	$65,713	2.47	8.61
11	PECIP	Pipe Insulation	12	333	$1,670	$3,879	2.32	8.58
12	PECIP	Removable Valve Insulation	13	10,595	$51,282	$143,711	2.80	7.34
13	QRIP	Replace Incandescent with Fluorescent Lamps	28	2,023	$37,660	$74,057	1.97	6.33
14	ECIP	Install Ceiling Insulation and Window Back Panels	1,2	8,848	$45,110	$194,887	4.32	4.76
15	ECIP	Weatherization, Solar Heating, Motor & Control Improvements	3,6,21, 24,25,27	6,606	$39,071	$207,245	5.30	2.57
16	ECIP	Lighting Fixture Improvements	30,31	2,792	$41,548	$209,914	5.05	2.50
17	PECIP	Daylighting Controls	34	152	$2,374	$7,447	3.14	2.34
18	PECIP	Occupancy Sensors	33	297	$2,418	$9,194	3.80	2.29
19	ECIP	Decentralize DHW System	8	16,965	82,111	$567,754	6.91	1.39
		Summary		143,947	$894,730	$1,663,118	1.86	7.30

TABLE 2

SUMMARY OF FAMILY HOUSING PROJECTS
FORT GORDON, GEORGIA

Proj No.	Funding Program	Project Title	ECO No.	Energy Savings MBTU/Yr	First Yr. Dollar Savings $/Yr.	Total Investment Cost $	Simple Payback Period Yrs.	SIR
20	**PECIP**	Low Flow Showerheads	FH-1	3,140	$18,564	$46,303	2.49	7.84
		Summary		3,140	$18,564	$46,303	2.49	7.84

TABLE 3

SURVEYED BUILDINGS LIST
FORT GORDON, GA

Building Number	Building Usage	Building Area Square Feet
2071	Family Housing	2,764
14600	Maintenance Shop	31,500
14604	General Storage	200
15500	Bowling Alley	15,000
18402	NCO Club	18,144
21606	Recrecation Center	18,405
21608	Natatorium	23,991
21706	Administration	12,100
21709	Mess Hall	13,275
25410	BEQ	11,958
25412	BEQ	23,493
25424	Administration	23,911
25440	Base PX	7,829
25510	Gym	21,493
25526	Office	10,270
25600	R&D	6,750
25601	Small Classroom	5,824
25603	Chapel	8,265
25702	Barracks	41,501
25703	Barracks	41,500
25706	Administration	12,100
25707	Barracks	41,501
25709	Mess Hall	13,275
25810	Large Classroom	148,146
28320	Arts & Crafts	15,436
28414	Chapel	8,957
28424	Administration	23,911
29300	Auto Shop	19,026
29601	Office	6,100
29607	Gym	20,070
29608	Chapel	8,903
29610	Small Office	6,108
29701	Administration	12,135
29702	Barracks	41,500
29704	Mess Hall	13,273
32100	Theater	16,475
35203	Cafeteria	10,200
36200	Bus Station	3,000
37300	Motel	30,600

Total Square Footage	788,889

II. RESULTS

A. Non-Housing

Of the 39 ECOs found to be applicable in non-housing, 33 had SIRs greater than or equal to one and 30 had paybacks less than ten years. The ECOs were packaged into 19 Projects. Figure 1 illustrates the SIRs for all 39 ECOs and is ranked by ECO number. Table 4 provides ECO names and numbers, SIRs, and other important data.

Figure 1 shows that SIRs range from over 100 to less than one. The top nine ECOs have SIRs above 10.0. These ECOs, too, are mostly simple, direct, straight forward and low-tech, which means easy implementation.

Figure 2 is similar to 1 but shows "first year dollar savings" for each ECO. This figure shows that the most dollar savings don't always come from the ECOs with the highest SIRs. Figure 3 and 4 illustrates SIRs and dollar savings by Project.

TABLE 4

SUMMARY OF NON-HOUSING ECOs
FORT GORDON, GA

ECO No.	ECO Title	Proj. No.	Energy Savings MBTU/Yr.	First Yr. Dollar Savings $/Yr.	Total Cost $	PB Period Yrs.	SIR
1	Ceiling/Attic Insulation	14	607	3,277	18,273	5.6	3.45
2	Window Back Panel	14	8,241	41,830	176,580	4.2	4.90
3	Solar Film	15	2,589	14,343	60,896	4.2	2.56
4	Weatherstrip/Caulk Doors &/or Windows	–	88	438	5,138	11.7	1.78
5	Replace Freezer Door Seals	9	119	1,546	984	0.6	11.62
6	Pool Cover	15	873	4,225	18,876	4.5	4.77
7	Airside Drybulb Economizer Cycles	–	184	1,499	23,222	N/A	0.66
8	Decentralize DHW System	19	16,965	82,109	567,754	6.9	1.39
9	New DHW Units	–	-82	541	6,077	N/A	-0.20
10	Ceiling Fans	–	38	183	3,886	N/A	0.66
11	Hot Water Reset	5	139	673	455	0.7	20.68
12	Pipe Insulation	11	333	1,670	3,879	2.3	8.58
13	Removable Valve Insulation	12	10,595	51,282	143,711	2.8	7.34
14	Steam Trap Replacement	8	8,379	40,556	13,246	0.3	14.67
15	Time Control of HVAC	2	206	2,675	397	0.1	65.80
16	OA On/Off Control of HW Pump	1	69,456	337,539	39,987	0.1	117.69
17	Night Setback Thermostat	4	3,170	15,342	4,636	0.3	46.26
18	Heating Retrofit - Move Pump	–	68	330	1,391	4.2	2.27
19	Dual Temperature Thermostats	7	1,724	12,315	9,493	0.8	15.33
20	Liquid Solar DHW Heating System	–	36,818	178,200	2,630,695	14.8	1.21
21	Solar Pool Heat	15	1,597	7,730	55,413	7.2	2.49
22	New Condenser/Compressor	–	46	596	39,518	N/A	0.15
23	More Efficient Boiler	10	5,486	26,552	65,713	2.5	8.61
24	Two Speed Motors	15	747	6,086	26,166	4.3	2.65
25	High Efficiency Motors	15	345	4,485	30,147	6.7	1.62
26	High Torque Drive Belts	–	149	3,205	25,521	8.0	1.19
27	Thermostatic Control Valves	15	455	2,202	15,746	7.2	1.96
28	Replace Incandescent with Fluorescent Lamps	13	2,023	37,660	74,057	2.0	6.33
29	Fixture Retrofit - Incandescent to Fluorescent	6	6,171	151,693	109,492	0.7	16.97
30	4 Lamp Fixture - Install Reflector and Delamp	16	822	12,214	53,781	4.4	2.87
31	2 Lamp Fixture Reflector - Barracks	16	1,970	29,337	156,133	5.3	2.38
32	Lamp and Ballast - HID to HPS	–	645	8,394	83,042	9.9	1.29
33	Occupancy Sensors	18	297	2,418	9,194	3.8	2.29
34	Daylighting Controls	17	152	2,374	7,447	3.1	2.34
35	FM Control for HVAC	3	487	2,595	626	0.2	54.35
36	Wall Insulation	–	321	1,662	44,655	N/A	0.73
37	Deciduous Shade Trees	–	49	245	3,974	16.2	1.28
38	Storm Window Retrofit	–	13	63	1,025	N/A	0.85
39	2 Lamp Fixture Reflector - Misc. Buildings	–	2,198	32,317	296,617	9.2	1.38

Fig. 1

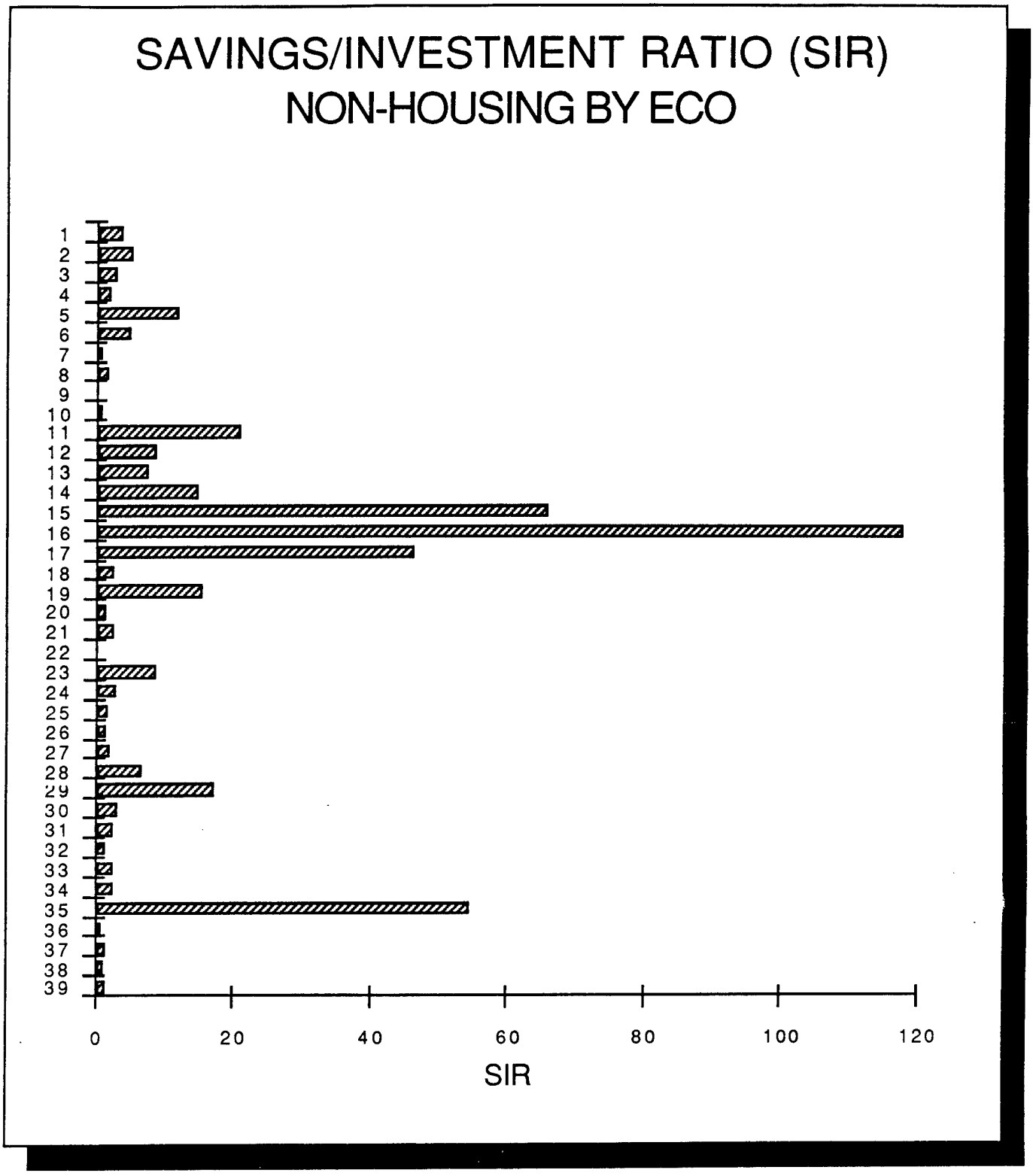

SAVINGS/INVESTMENT RATIO (SIR)
NON-HOUSING BY ECO
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
0
20
40
60
80
100
120
SIR

Fig. 2

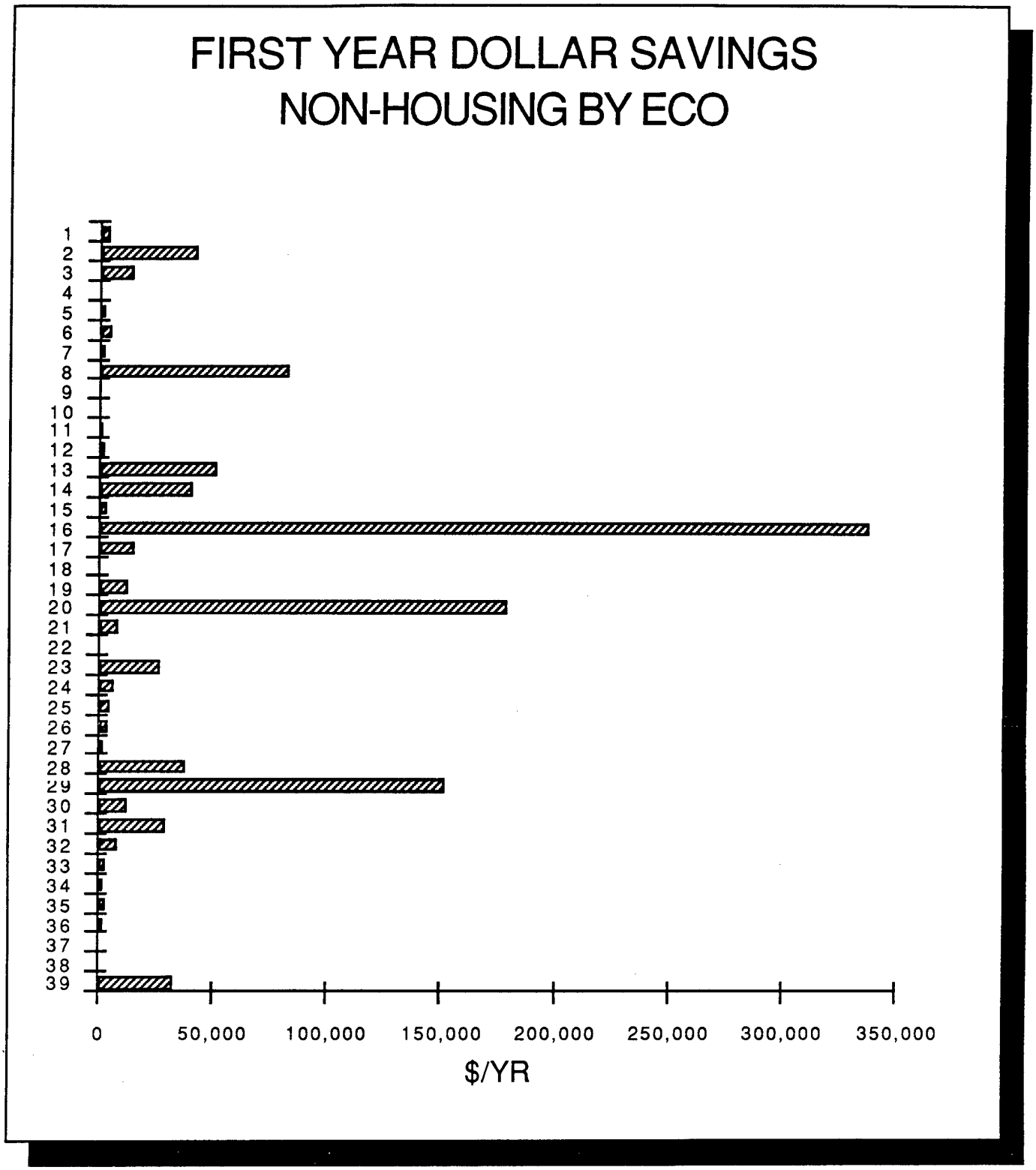

FIRST YEAR DOLLAR SAVINGS
NON-HOUSING BY ECO
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
0
50,000
100,000
150,000
200,000
250,000
300,000
350,000
$/YR

Figure 3

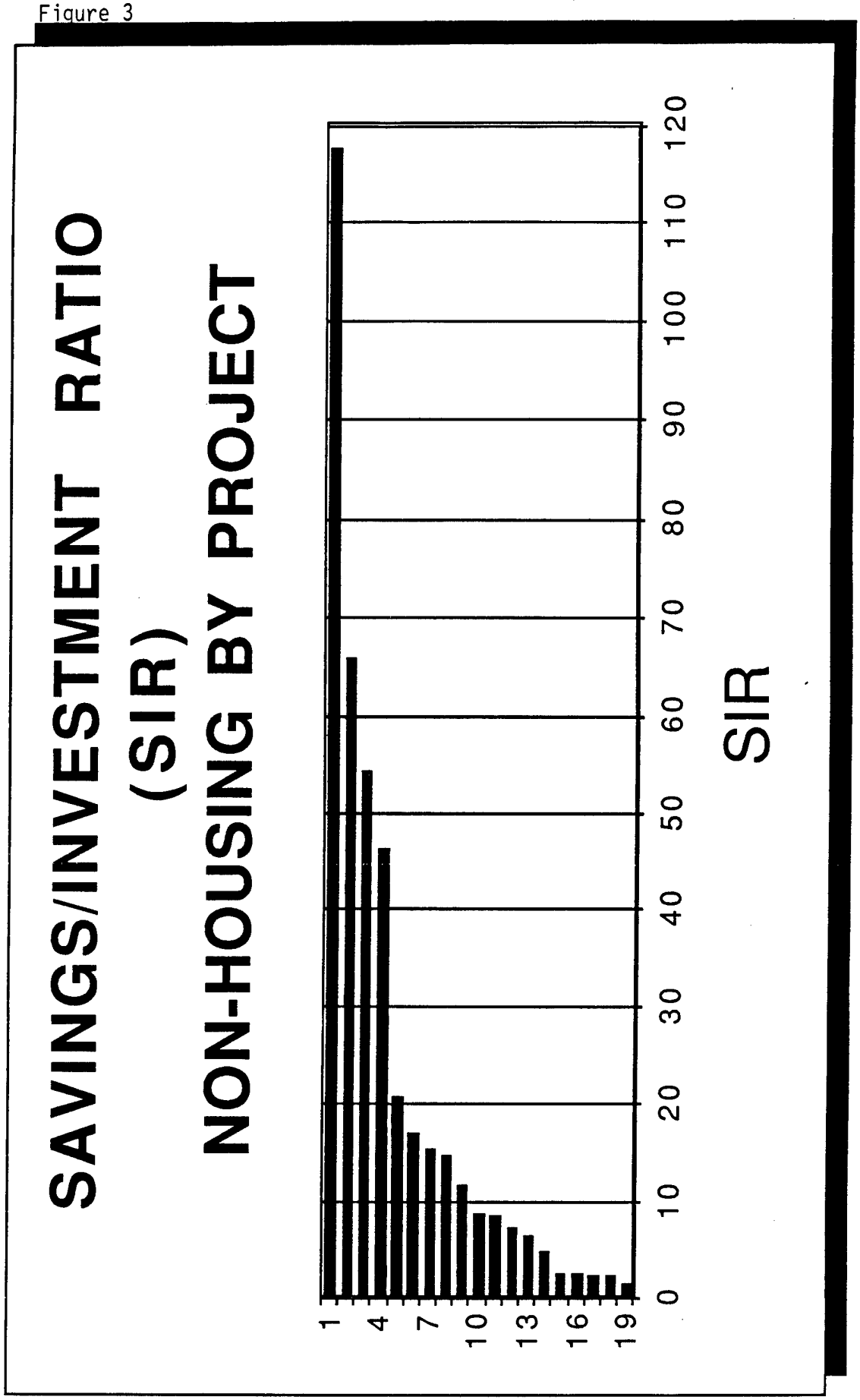
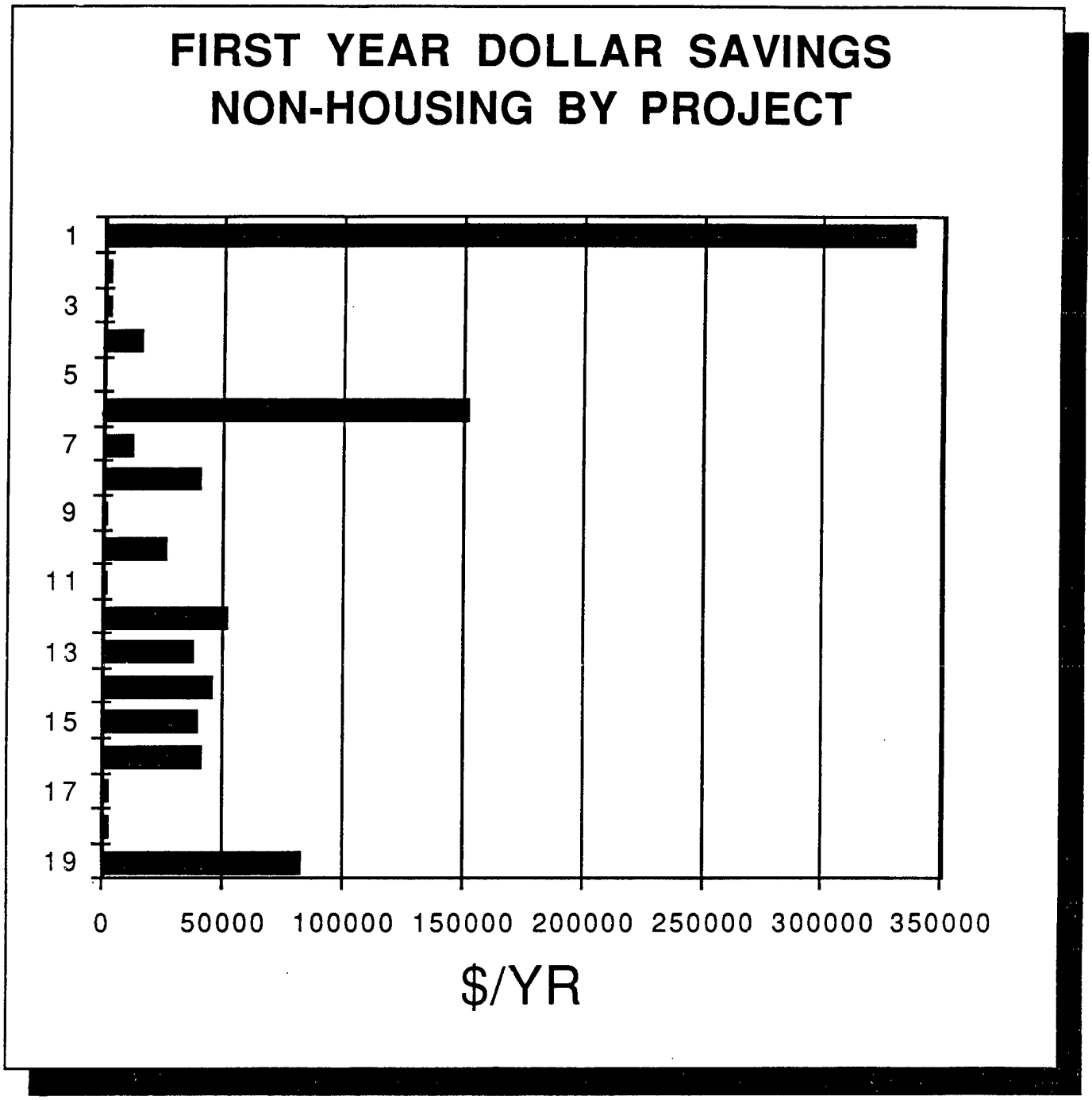

SAVINGS/INVESTMENT RATIO
(SIR)
NON-HOUSING BY PROJECT
0
10
20
30
40
50
60
70
80
90
100
110
120
SIR
1
4
7
10
13
16
19

Figure 4


FIRST YEAR DOLLAR SAVINGS
NON-HOUSING BY PROJECT
1
3
5
7
9
11
13
15
17
19
0
50000
100000
150000
200000
250000
300000
350000
$/YR

B. Family Housing

Of the 5 ECOs found to be applicable in family housing, 4 had SIRs greater than or equal to one and 3 have paybacks of less than ten years. One has been programmed as a project. Figure 5 illustrates the SIRs for all 5 ECOs and is ranked by ECO number. Table 5 provides ECO names and numbers, and other important data.

The SIRs range from nearly 8 to less than one. The top two ECOs have paybacks less than five years. These ECOs, too, are fairly simple, direct, straight forward and low-tech, which means easy implementation.

Figure 6 is similar to 5 but shows "first year dollar savings" for each ECO. This figure shows that the most dollar savings don't always come from the ECOs with the highest SIRs.

TABLE 5

SUMMARY OF FAMILY-HOUSING ECOs
FORT GORDON, GA

ECO No.	ECO Title	Proj. No.	Energy Savings MBTU/Yr.	First Yr. Dollar Savings $/Yr.	Total Cost $	PB Period Yrs.	SIR
FH-1	Low Flow Showerheads	20	3,140	18,564	46,303	2.5	7.84
FH-2	DHW Tank Insulation	–	1	4	77	N/A	1.01
FH-3	Furnace Retrofit	–	53	256	2,423	9.5	1.48
FH-4	Electric Spark Pilot Retrofit	–	4	17	383	N/A	0.44
FH-5	Fixture Retrofit - Incandescent to Fluorescent	–	1	13	66	4.9	2.54

Fig. 5

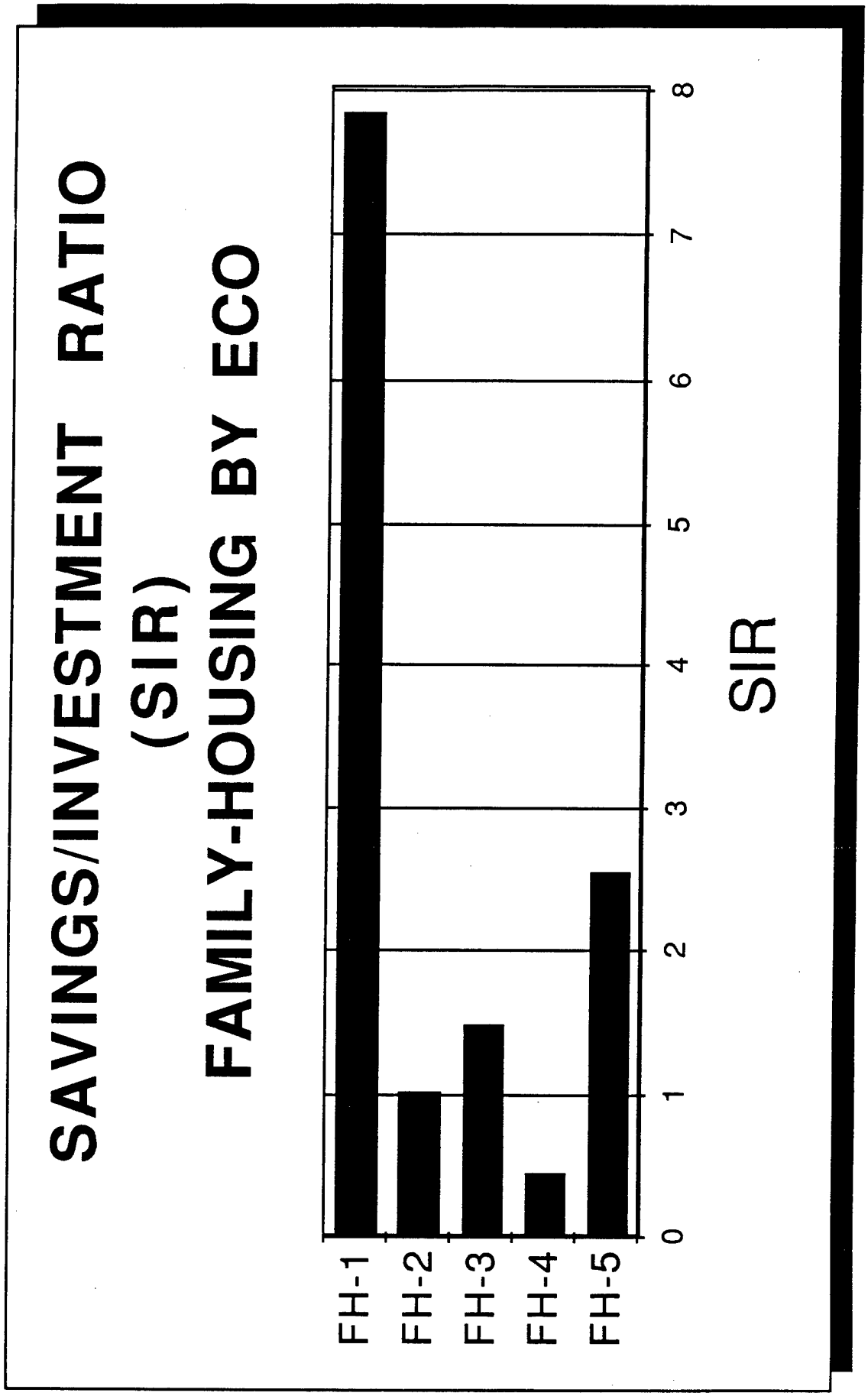
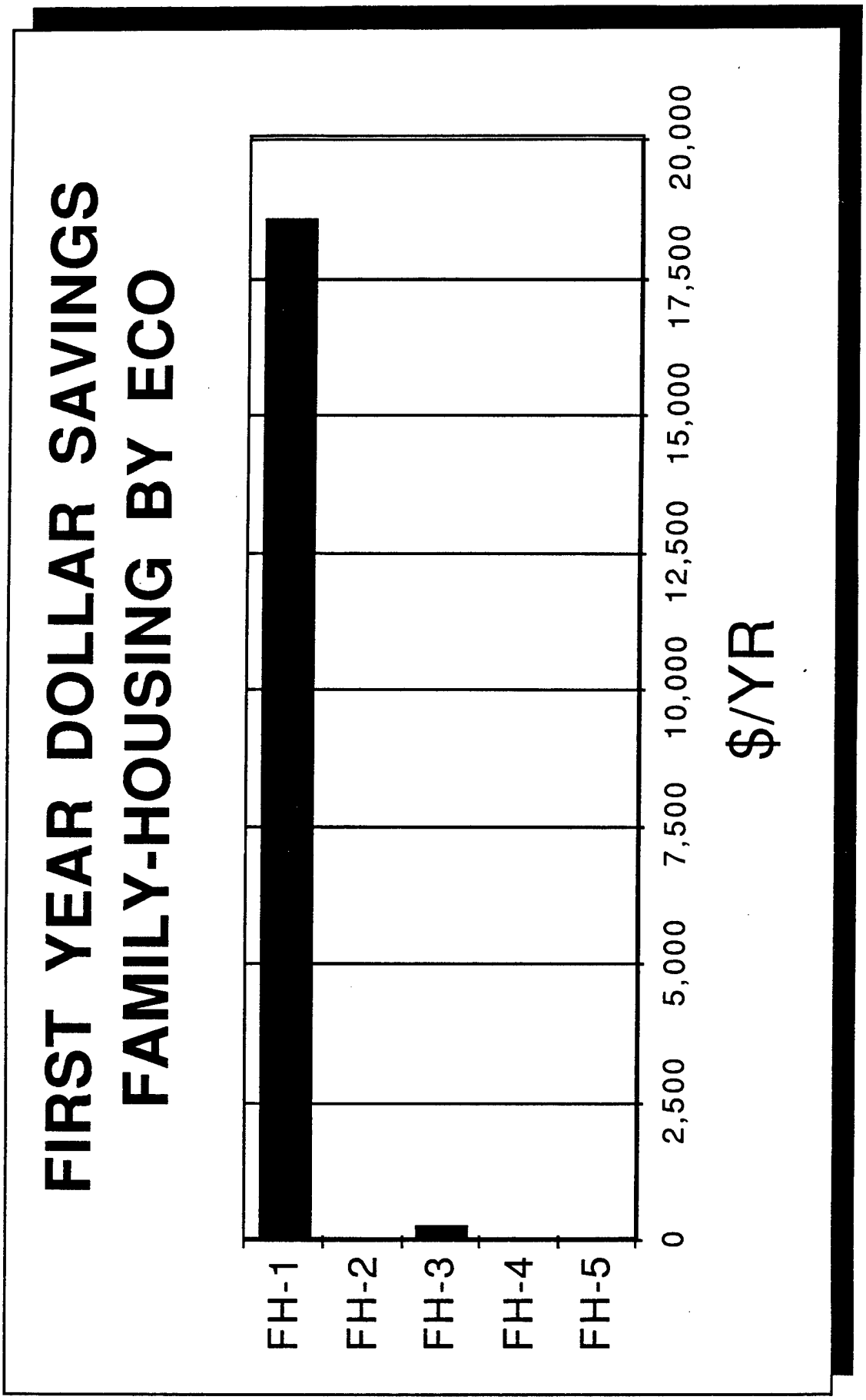

SAVINGS/INVESTMENT RATIO
(SIR)
FAMILY-HOUSING BY ECO
FH-1
FH-2
FH-3
FH-4
FH-5
0
1
2
3
4
5
6
7
8
SIR

Fig. 6


FIRST YEAR DOLLAR SAVINGS
FAMILY-HOUSING BY ECO
0
2,500
5,000
7,500
10,000
12,500
15,000
17,500
20,000
$/YR
FH-1
FH-2
FH-3
FH-4
FH-5

III. PROJECT SCOPE

Criteria for the study and the documentation have changed since the previous study was completed. The previous study was a basewide Energy Engineering Analysis Program (EEAP) performed in 1979-80 by another AE. The ESOS is intended to re-evaluate selected projects from the previous study and to consider specific ECOs in buildings that may have been overlooked previously or recently identified.

A limited site survey of selected buildings or areas was performed to ensure that any new methods of energy conservation which are practical and have not been evaluated in any previous study have been considered and the results documented. Based upon on the interim submittal comments, Heery prepared programming or implementation documentation for all ECOs selected by DIS and a comprehensive report on the work, results, and recommendations.

The emphasis in the Scope of Work is on ECOs that are practical, appropriate, and not previously accomplished. Also, ECOs that can be eliminated from detailed analysis by a preliminary analysis shall be ruled out.

A "snapshot" approach is taken in this ESOS. In effect, everything is frozen in time, with the base year for this ESOS being 1986. Utility rates used were the previous full year's data available during the base year. For project programming, project costs were escalated to FY 89 per the SOW.

In preparing LCCAs and project packaging, Savannah Energy Conservation Investment Program (ECIP) Guidance was followed.

As stated in ASHRAE's Heating and Cooling Load Calculation Manual, page 7.1 "a load calculation is not an energy calculation," This is an important distinction when analyzing the ECOs and illustrates that other factors must be considered before drawing conclusions regarding building loads from the energy calculations developed in this report.

Synergistic Effects

All ECOs that use heating or cooling degree hours, or equipment efficiency data in their calculations presume that nine "primary" ECOs, listed below, were implemented first. The nine are ECOs that would affect equipment operating hours or equipment efficiencies. The nine primary ECOs are:

11	Hot Water Reset
15	Time Control of HVAC
16	Outside Temperature Control of Space Heating
17	Night Setback Thermostat
19	Dual Temperature Thermostat
23	More Efficient Boilers
27	Thermostatic Control Valves
35	FM Control for HVAC
FH3	Furnace Retrofit

The nine were chosen because they would cause interactions with other ECOs. In the event that two or more of these were being evaluated for the same building, each one assumed that the other ECO was in place, to account for interactions.

IV. SUMMARY

The total of energy savings from all programmed family housing ECOs is 3,140 MBTU/year and $18,600/year. With a total cost of $46,000 this yields an average payback of 2.5 years and an average SIR of 7.8.

The total of energy savings from all programmed non-housing ECOs is 144,000 MBTU/year and $900,000/year. With a total cost of $1.7 million this yields an average payback of 1.9 years and an average SIR of 7.3.

Some very fast payback projects have been developed in this report for Fort Gordon. These should be implemented as quickly as possible.

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